Fall 2017 EE511 Simulation

Project 7: due Wednesday/Thursday November 29/30 (20 points)

In this project, you are asked to simulate teller operations in a bank. The customer arrival process is Poisson (i.e. the interarrival times are iid exponentially distributed) with arrival rate λ. 75% of the customers have a simple transaction to do; a simple transaction takes an amount of time that can be modelled by an Erlang-2 distribution with mean $\mu_{simple} = 2$ minutes. The other 25% of customers have complex transactions to do; complex transactions take an amount of time that can be modeled by an Erlang-5 distribution with mean $\mu_{complex} = 6$ minutes.

Matlab has built-in capability to generate RV's according to an Erlang distribution, but I would like you to generate the values using the technique explored in Project 6 part B, i.e.

$$S_n = \frac{-\ln\left(\prod_{i=1}^{n} U_i\right)}{\mu}$$

Be sure to set n and μ appropriately to match the desired type of Erlang.

You can assume that there are 3 tellers and an infinite amount of space is available to accommodate waiting customers. For strategy 1 and 2 assume that all tellers can handle any type of transaction. Consider the following 3 queueing strategies.

1. There is a single queue. When a teller becomes free, the person at the head of the queue is served next.

2. Each teller has a separate queue. An arriving customer joins the shortest queue (and is not allowed to switch queues).

3. There are two queues. One for simple transactions and one for complex transactions. When a customer arrives, they join the appropriate queue. One teller (a relatively new hire) can handle only simple transactions, so is only able to accept customers from the simple transaction queue. The other two tellers are more experienced and can handle both simple and complex transactions. When an experienced teller becomes free and both queues are non-empty the teller randomly chooses to take the next customer from either queue. If only one of the queues has customers in it, then the teller accepts the next customer from that queue. If there are no customers in either queue, the teller becomes idle. When a customer arrives to find the queues empty and one

or more tellers available, they randomly select a teller (subject to constraints on the type of service required, i.e. a customer with a complex transaction cannot be served by the new hire.)

Simulate these systems and compare customer queue length distributions, waiting times (i.e. time spent waiting before being served), broken down by customer type for a variety of customer arrival rates. This should include estimates of the mean and variance of these statistics (and optionally estimate of the distribution of queue length, i.e. the pmf). Also, determine the fraction of time that the servers are idle (and any other statistics you find interesting.)